

CLAIMS

WE CLAIM:

1. A receiver for a multi-carrier CDMA system for receiving a signal transmitted on plural sub-carriers each having a known pilot sequence, comprising:
 - a plurality of down-converters down-converting the received signal to baseband signals;
 - a delay and channel estimator correlating at least one of the baseband signals with a single wideband pilot signal, the single wideband pilot signal comprising all of the known pilot sequences, to produce an estimate of channel gain and multi-path delay; and
 - a plurality of demodulators, one for each of the plural sub-carriers, and operatively coupled to the delay and channel estimator, each demodulating one of the plural baseband signals using the estimate of channel gain and multi-path delay.
2. The receiver of claim 1 wherein the plurality of down-converters comprise one for each sub-carrier.
3. The receiver of claim 1 wherein the plurality of down-converters comprise a plurality of sub-carrier down-converters, one for each sub-carrier, and a composite down-converter down-converting the received signal to a composite baseband signal.
4. The receiver of claim 3 wherein the delay and channel estimator is operatively coupled to the composite down converter for correlating the composite baseband signal with a composite of the known pilot sequence to produce an estimate of channel gain and multi-path delay.

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5. The receiver of claim 1 wherein the delay and channel estimator comprises a plurality of correlators, one for each sub-carrier, and outputs of each of the plurality of correlators are combined to produce the estimate of channel gain and multi-path delay.

6. The receiver of claim 1 further comprising a plurality of correlators, one for each down-converter, each correlating one of the baseband signals with the known pilot sequence for one of the sub-carriers, to produce an estimate of channel gain and multi-path delay, and wherein the plurality of demodulators selectively demodulate the plural baseband signals using either the estimate of channel gain and multi-path delay produced by the delay and channel estimator or the estimate of channel gain and multi-path delay produced by the plurality of correlators.

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7. A receiver for a multi-carrier CDMA system for receiving a signal transmitted having a known pilot sequence on plural sub-carriers, comprising:

a plurality of sub-carrier down-converters and filters, one for each sub-carrier, each down-converting the received signal to baseband and removing the other sub-carriers to provide plural sub-carrier baseband signals;

a composite down-converter down-converting the received signal to a composite baseband signal;

a delay and channel estimator operatively coupled to the composite down converter correlating the composite baseband signal with a composite of the known pilot sequence to produce an estimate of channel gain and multi-path delay; and

a plurality of demodulators, each operatively connected to one of the sub-carrier down-converters and filters and to the delay and channel estimator, each demodulating one of the plural sub-carrier baseband signals using the estimate of channel gain and multi-path delay.

8. The receiver of claim 7 wherein the composite down converter down-converts the received signal relative to a center carrier frequency and the sub-carriers are separated with respect to the center carrier frequency.

9. The receiver of claim 8 wherein the composite of the known pilot sequence comprises a sum of the known pilot sequences.

10. The receiver of claim 7 further comprising a plurality of correlators, one for each down-converter, each correlating one of the baseband signals with the known pilot sequence for one of the sub-carriers, to produce an estimate of channel gain and multi-path delay, and wherein the plurality of demodulators selectively demodulate the plural baseband signals using either the estimate of channel gain and multi-path delay produced by the delay and channel estimator or the estimate of channel gain and multi-path delay produced by the plurality of correlators.

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11. A receiver for a multi-carrier CDMA system for receiving a signal transmitted
2 on plural sub-carriers each having a known pilot sequence, comprising:

4 a plurality of sub-carrier down-converters and filters, one for each sub-carrier, each
down-converting the received signal to baseband and removing the other sub-carriers to provide
plural sub-carrier baseband signals;

6 a delay and channel estimator comprising a plurality of correlators, each correlating
one of the sub-carrier baseband signals with the known pilot sequence for the one sub-carrier, and
8 operative to combine outputs of the plurality of correlators to produce an estimate of channel gain
and multi-path delay; and

10 a plurality of demodulators, one for each of the plural sub-carriers and operatively
coupled to the delay and channel estimator, each demodulating one of the plural baseband signals
12 using the estimate of channel gain and multi-path delay.

12. The receiver of claim 11 wherein the delay and channel estimator identifies
multi-paths and relative delays for the multi-paths using threshold comparison.

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13. A method of synthesizing a radio channel profile for a multi-carrier CDMA
2 receiver receiving a signal transmitted on plural sub-carriers, comprising:
down-converting the received signal to baseband and removing the other sub-carriers
4 to provide plural sub-carrier baseband signals;
correlating each of the sub-carrier baseband signals with a known pilot sequence;
6 sampling each of the correlated sub-carrier baseband signals;
transforming each of the sampled, correlated sub-carrier baseband signals to a discrete
8 time domain;
combining the transformed baseband signals to produce a combined discrete time
10 domain signal; and
inverse transforming the combined discrete time domain signal to produce a composite
12 correlation output signal.

14. The method of claim 13 wherein sampling each of the correlated sub-carrier
baseband signals comprises sampling each of the correlated sub-carrier baseband signals at Nyquist
rate .

15. The method of claim 13 wherein sampling each of the correlated sub-carrier
baseband signals comprises sampling each of the correlated sub-carrier baseband signals at greater
than Nyquist rate .

16. The method of claim 13 wherein transforming each of the sampled, correlated
sub-carrier baseband signals to a discrete time domain comprises forming discrete Fourier transforms
for each of the sampled, correlated sub-carrier baseband signals.

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17. The method of claim 13 wherein combining the transformed baseband signals
2 to produce a combined discrete time domain signal comprises computing a carrier frequency offset
in time domain for each of the sub-carriers and summing the transformed baseband signals using the
4 carrier frequency offsets in the time domain.

18. The method of claim 16 wherein inverse transforming the combined discrete
2 time domain signal to produce a composite correlation output signal comprises calculating an inverse
discrete Fourier transform for the combined discrete time domain signal.

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19. A mobile terminal for a multi-carrier CDMA system comprising:

2 a receiver for receiving a signal transmitted on plural sub-carriers each having a
known pilot sequence comprising a plurality of down-converters down-converting the received signal
4 to baseband signals, a delay and channel estimator correlating at least one of the baseband signals with
a single wideband pilot signal, the single wideband pilot signal comprising all of the known pilot
6 sequences, to produce an estimate of channel gain and multi-path delay, and a plurality of
demodulators, one for each of the plural sub-carriers, and operatively coupled to the delay and
8 channel estimator, each demodulating one of the plural baseband signals using the estimate of channel
gain and multi-path delay.

20. The mobile terminal of claim 19 wherein the plurality of down-converters
comprise one for each sub-carrier.

21. The mobile terminal of claim 19 wherein the plurality of down-converters
comprise a plurality of sub-carrier down-converters, one for each sub-carrier, and a composite down-
converter down-converting the received signal to a composite baseband signal.

22. The mobile terminal of claim 21 wherein the delay and channel estimator is
operatively coupled to the composite down converter for correlating the composite baseband signal
with a composite of the known pilot sequence to produce an estimate of channel gain and multi-path
4 delay.

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25. A base station for a multi-carrier CDMA system comprising:

2 a receiver for receiving a signal transmitted on plural sub-carriers each having a
known pilot sequence comprising a plurality of down-converters down-converting the received signal
4 to baseband signals, a delay and channel estimator correlating at least one of the baseband signals with
a single wideband pilot signal, the single wideband pilot signal comprising all of the known pilot
6 sequences, to produce an estimate of channel gain and multi-path delay, and a plurality of
demodulators, one for each of the plural sub-carriers, and operatively coupled to the delay and
8 channel estimator, each demodulating one of the plural baseband signals using the estimate of channel
gain and multi-path delay.

26. The base station of claim 25 wherein the plurality of down-converters comprise
one for each sub-carrier.

27. The base station of claim 25 wherein the plurality of down-converters comprise
a plurality of sub-carrier down-converters, one for each sub-carrier, and a composite down-converter
down-converting the received signal to a composite baseband signal.

28. The base station of claim 27 wherein the delay and channel estimator is
operatively coupled to the composite down converter for correlating the composite baseband signal
with a composite of the known pilot sequence to produce an estimate of channel gain and multi-path
4 delay.

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29. The base station of claim 25 wherein the delay and channel estimator comprises
2 a plurality of correlators, one for each sub-carrier, and outputs of each of the plurality of correlators
are combined to produce the estimate of channel gain and multi-path delay.

30. The base station of claim 25 further comprising a plurality of correlators, one
2 for each down-converter, each correlating one of the baseband signals with the known pilot sequence
for one of the sub-carriers, to produce an estimate of channel gain and multi-path delay, and wherein
4 the plurality of demodulators selectively demodulate the plural baseband signals using either the
estimate of channel gain and multi-path delay produced by the delay and channel estimator or the
6 estimate of channel gain and multi-path delay produced by the plurality of correlators.

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